COMESEP Deliverable D2.1

Repository of in situ data [Task 2.1]

Leer, Kristoffer; Vennerstrøm, Susanne; Ibsen, Tina; Rodriguez, L. ; Veronig, A.; Moestl, C.

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Authors: K. Leer, S. Vennerstrom, T. Ibsen, L. Rodriguez, A. Veronig, C. Moestl

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Dissemination Level		
PU	Public	**X**
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

NOTICE

TABLE OF CONTENTS

1. Description

The main goal of this task is to compile a collection of relevant in-situ magnetic field and plasma data (proton density (Np), proton velocity (Vp), proton temperature (Tp)), as well as lists of related space weather events, which can be used for other tasks (especially Tasks 2.2-2.4 and Task 5.3). The data is collected from NASA data servers and kindly provided by scientists. All data is accessible for the COMESEP consortium at the DTU server: comesep.spacecenter.dk . This server is the main part of the deliverable; this document serves as a short description of the contents of the server.

2. Overview of in-situ data

The server will be updated continuously when new data is available. Since July 2012 three groups of data (Magnetometer, Mars Proxy and Plasma) are available. They are described in the following sub-sections.

2.1. Magnetometer data

- Ace (1997-2011)
- Cassini (1999-2001)
- Messenger (2004-2011)
- Near (1997-2000)
- STEREO A&B (2007-2011)
- Ulysses (1991-2004)
- Venus Express (2008-2010)

Ulysses and STEREO data was found on http://aten.igpp.ucla.edu/. Note that Ulysses data is no longer available here.

Venus Express data was delivered by VEX MAG PI Tielong Zhang from the Space Research Institute, Austrian Academy of Sciences and Christian Moestl (UNIGRAZ).

The rest of the data has been downloaded from http://ppi.pds.nasa.gov. The data was subsequently converted into similar file formats and coordinate systems, and heliospheric position information was included as described below.

Table 1 is a complete list of the structure of the columns in the final data files. Here is a short description of the content:

The time is given in three different systems: Datenum, Julian Day 2000 (jd2000) and year, month, day + ut.

- Datenum is the time in decimal days after January 1th year 0 (easily calculated in matlab), with this date equal to 0. The time step is 1 minute.

The positions of the spacecraft is given in km in the following coordinate system:

- Ecliptic and Mean Equinox of Reference Epoch
- Reference epoch: J2000.0
- xy-plane: plane of the Earth's orbit at the reference epoch
- x-axis : out along ascending node of instantaneous plane of the Earth's orbit and the Earth's mean equator at the reference epoch
- z-axis : perpendicular to the xy-plane in the directional (+ or -) sense of Earth's north pole at the reference epoch.

More information about the position of the spacecraft and the description of the coordinate system are found on http://ssd.jpl.nasa.gov/horizons.cgi#top

All magnetometer data set are delivered in units of nano tesla. Magnetometer data is given in RTN coordinates with exception of NEAR which is given in NEAR Sun Orbital (NSO) coordinates.

- RTN coordinates consist of R (radial component, Sun to the spacecraft), T (tangential component, parallel to the Solar Equatorial plane and perpendicular to R), and N (normal component, completes right handed set).
- NEAR Sun Orbital (NSO) coordinates are Cartesian coordinates defined with respect to the NEAR-Sun line and the orbit plane of Eros. The X-axis points from NEAR to the Sun, the Z direction is given by the Eros velocity vector crossed into X, northward normal to the Eros orbital plane, and Y completes the right-handed set.

File columns:

1) Datenum
2) JD2000
3) Year (yy)
4) Month
5) Day of month
6) UT hour of day
7) Spacecraft x-coordinate in km
8) Spacecraft y-coordinate in km
9) Spacecraft z-coordinate in km
10) Scalar magnitude of magnetic field in nT
11) Radial component (RTN system) of vector magnetic field in nT
12) Transverse component (RTN system) of vector magnetic field in nT
13) Normal component (RTN system) of vector magnetic field in nT
14) Radial distance from spacecraft to Sun in km
15) Latitude of spacecraft over ecliptic plane in degrees
16) Azimuth between spacecraft-Sun and Earth-Sun in degrees
17) Azimuth Earth in degrees
18) Azimuth spacecraft-Sun in degrees

Table 1: Overview of the structure of magnetometer data

2.2 Mars Proxy data

The server also hosts Mars Global Surveyor (MGS) solar wind proxy data for the time period 1999-2006. The Mars proxy data is given in approximately 2 hours intervals, corresponding to one orbit of MGS. The data contain solar wind dynamic pressure proxy, clock angle and total magnitude of magnetic field in the magnetic pile-up region of Mars. The data is organized as listed in Table 2.

File columns:

1) Datenum
2) JD2000
3) Year (yy)
4) Month
5) Day of month
6) UT hour of day
7) Spacecraft x-coordinate in km
8) Spacecraft y-coordinate in km
9) Spacecraft z-coordinate in km
10) MGS orbit number
11) Solar wind dynamic pressure proxy in nP.
12) Clock angle in degrees (between -180 and 180)
13) Scalar magnitude of magnetic field in the pile-up region nT
14) Radial distance from spacecraft to Sun in km
15) Latitude of spacecraft over ecliptic plane in degrees
16) Azimuth between spacecraft-Sun and Earth-Sun in degrees
17) Azimuth Earth in degrees
18) Azimuth spacecraft-Sun in degrees

Table 2: Overview of the structure of MGS proxy data

The dynamic pressure proxy is calculated through the magnetic pressure: as:

$$P = \frac{B^2}{2\mu_0}$$

where B is the average over all points less than 60^0 from the subsolar point and thereafter corrected for the angular distance to the subsolar point. Details can be found in Vennerstrom et al. (2003). The clock-angle was calculated according to the method of Fedorov et al. (2006).

2.3 Plasma data

The server has two sets of plasma data originating from two spacecraft: 1. Ulysses (1991-2005) and 2. STEREO (2007-2011). The structure of the STEREO data is shown in Table 3 and is similar for Ulysses. Note, that the data in column 10-14 is different for the two satellites.

File columns:

1) Datenum
2) JD2000
3) Year (yy)
4) Month
5) Day of month
6) UT hour of day
7) Spacecraft x-coordinate in km
8) Spacecraft y-coordinate in km
9) Spacecraft z-coordinate in km
10) Ulysse, STEREO: proton number density per cubic centimeter
11) Ulysse: alpha number density per cubic centimeter, STEREO: Velocity (km/s)
12) Ulysse: proton temperature (Tlarge) , STEREO: proton temperature (K)
13) Ulysse: proton temperature (Tsmall) , STEREO: BETA
14) Radial distance from spacecraft to Sun in km
15) Latitude of spacecraft over ecliptic plane in degrees
16) Azimuth between spacecraft-Sun and Earth-Sun in degrees
17) Azimuth Earth in degrees
18) Azimuth spacecraft-Sun in degrees

Table 3: Overview of the structure of STEREO plasma data

3 The in-situ data server

The data is available at the DTU sftp-server: comesep.spacecenter.dk. Login and password are given to COMESEP members at different occasions. Members are allowed to upload their own data products on the server to share it with the rest of the group. This data can be any kind, text files, matlab files, graphs, images or whatever relevant.

4 Additional

4.1. Tools

The server has a toolbox where scripts and other useful tools can be uploaded. The Matlab program iEphems1 is currently available. It is a tool for viewing the positions of planets and satellites from which data is available. The program covers the time period 1990-2011 and the temporal resolution is one day.

To use the iEphems tool you need to run it through Matlab. The program has an interface where a date can be specified; thereafter iEphmes1 plots the positions of planets and satellites in the ecliptic plane for the given date. In Figure 1 the interface of iEphems is shown for the date 25 Dec. 2009.

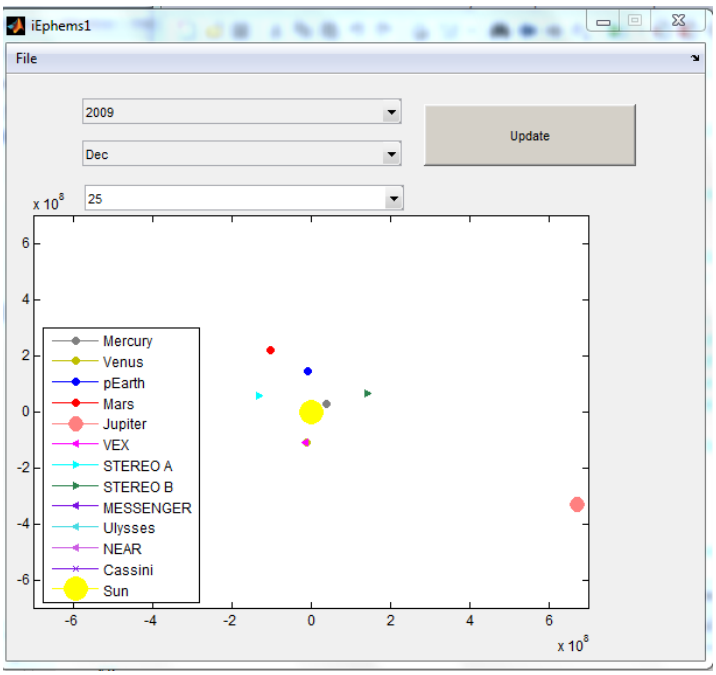

Figure 1: Layout of iEphems1. As an example, the positions of the planets and satellites for 25 Dec. 2009 are shown.

4.2. Lists

The server also hosts a folder with relevant list, which include several ICME lists and cloud lists.

The ICME lists has been taken from: Jian et al. (2006), Kilpua et al. (2009), Moestl (2011), Richardson & Cane (2010), Ulysses ICME list (2008),

The cloud lists originates from: Huttunen et al., (2005), Lepping (Weblink 2012),

These lists will be updated when new are available.

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